

CRC/NREL Proximate Modeling - Initial Results for the NOx Reduction and Timing Hypotheses

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Presented by
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Sponsors

- **Coordinating Research Council**
- **NREL**
 - co-funded by the U.S. Department of Energy Office of Heavy Vehicle Technologies through NREL and CRC

Presentation Outline

- **Study Overview (Recap)**
- **Modeling Databases**
- **Simulations and Hypotheses**
- **Emissions Methodology**
- **Modeling Results**
- **Summary**

Study Overview

- **Investigate WD/WE emissions/air quality relationships for Los Angeles**
 - quantitative evaluation using the CAMx grid model
 - simple representations of WD/WE emission changes (proximate modeling)
 - evaluate all hypotheses for 1997
 - evaluate promising hypotheses for 1987 and 2010
- **Project team**
 - ENVIRON: Greg Yarwood, Ralph Morris, Till Stoeckenius
 - AIR: Jon Heuss, Jeremy Heiken
- **See November 16, 1999 Presentation**

Modeling System

- **Episode: August 3-7, 1997 (Sun - Thur)**
- **Domain: SCAQMD AQMP domain**
- **Meteorology: MM5 assimilating SCOS and Eta data**
- **Air Quality Model: CAMx version 3.01**
- **Emissions: ARB SCOS97 inventories**
 - EMFAC2000 motor vehicle emissions
 - BEIGIS biogenic emissions
- **Excellent Model Performance (July 11 Report)**

Proposed Simulations and ARB Hypotheses

#	<i>Our Description</i>	<i>ARB Hypothesis</i>
1	Reduced NOx Mass from reduced WE truck traffic	NOx reduction
2	Different temporal/spatial pattern of WE traffic	NOx timing
3	Different Friday traffic	Carryover aloft and NOx reduction/timing
4	Carryover from Fri/Sat/Sun	Carryover aloft
5	Increased WE recreation emissions	ARB concluded not plausible
6	Reduced WE commercial emissions	ARB concluded not plausible

Emissions Methodology

- **Base Case: Make every day a weekday**
 - base onroad MV emissions on 6-Aug (originally a Wednesday)
 - keep original biogenic and other anthro
 - replace other anthro for 3-Aug (Sun) by 4-Aug
- **WE scenarios for hypotheses 1 and 2**
 - put a weekend on August 5 and 6
 - apply WE adjustment for onroad MV mass and/or temporal profile within five SCAG counties

Method

- **Traffic count data used as a surrogate for temporal variation in emissions**
 - began with SCOS97 August 6 inventory (Wednesday)
 - calculated average temporal profiles by category
 - preserved spatial distribution of Aug-6 inventory
 - adjusted daily emissions based on total daily counts
 - apportioned hourly emissions to temporal profile of count data

Traffic Count Data

- **NREL/DOE sponsored study* collected data in the South Coast Air Basin (Sep-Oct 2000)**
 - light and heavy duty vehicles evaluated separately
 - used freeway data
 - used interior basin data (average of 6 sites)

* See June 29, 2001 presentation “Weekday Versus Weekend Emissions Activity Patterns in the South Coast Air Basin,” presented by Sonoma Technology, Inc. sponsored by NREL and DOE’s Office of Heavy Vehicle Technologies.

Assumptions by Process

Process	Daily Mass Adjustment	Hourly Apportionment
Exhaust, hot soak, running loss	Direct proportion to count data	Direct proportion to count data
Diurnal	Inverse proportion to 6am - 2pm count data	No change*
Resting Loss	No change	No change

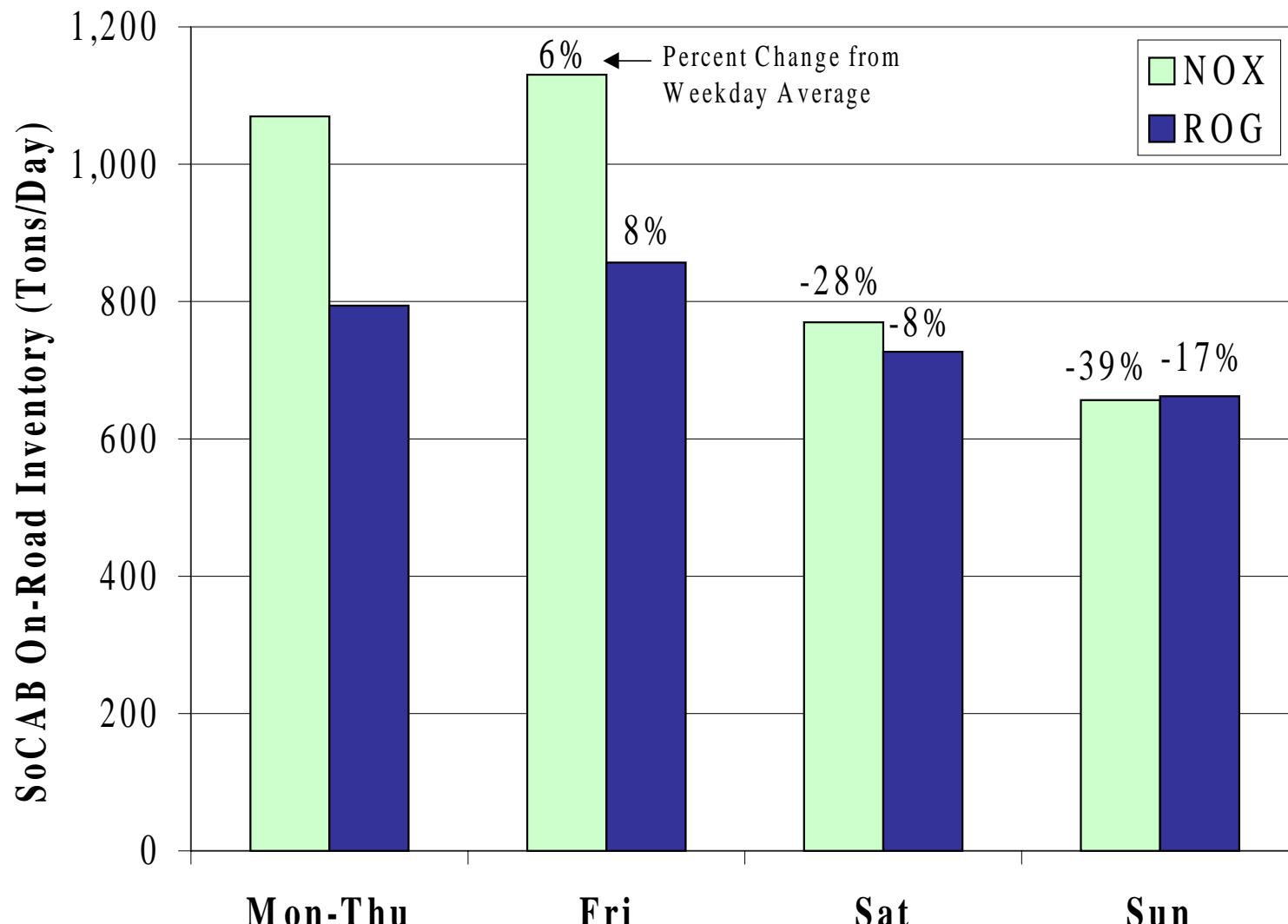
* *No change* = average SCOS97 temporal profile for 6-Aug used for all days of week

Day-of-Week Emissions Adjustment

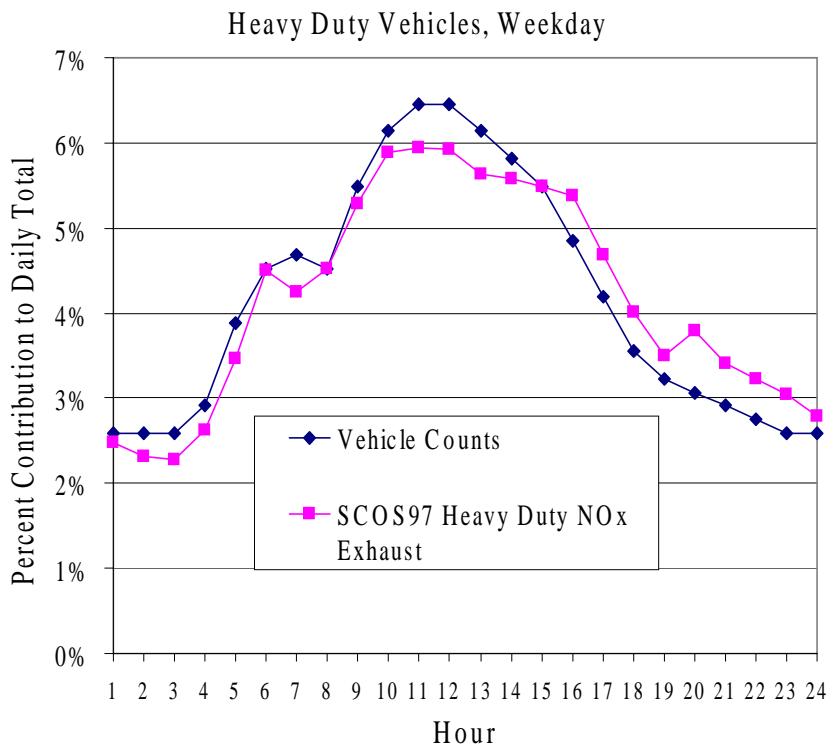
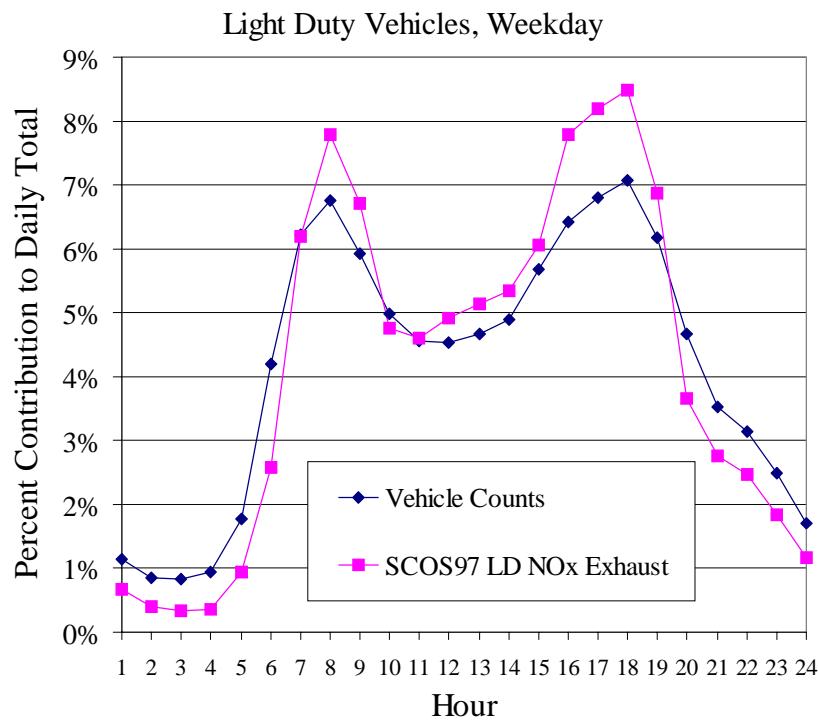
Change in Daily Emissions from Weekday Average				
Vehicle Class	Process	Fri	Sat	Sun
Light-Duty	Exhaust/Hot Soak/Running Loss	10%	-7%	-19%
	Diurnal	-3%	23%	59%
Heavy-Duty	Exhaust/Hot Soak/Running Loss	0%	-57%	-66%
	Diurnal	0%	136%	289%

- **Mon-Thu = light-duty weekday average**
- **Mon-Fri = heavy-duty weekday average**

On-road MV Emission Inventory

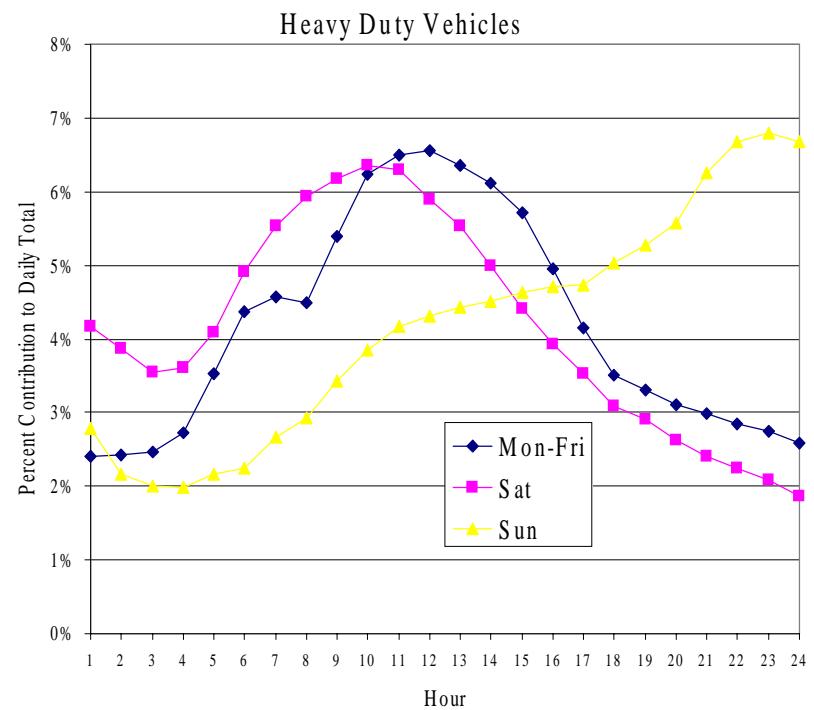
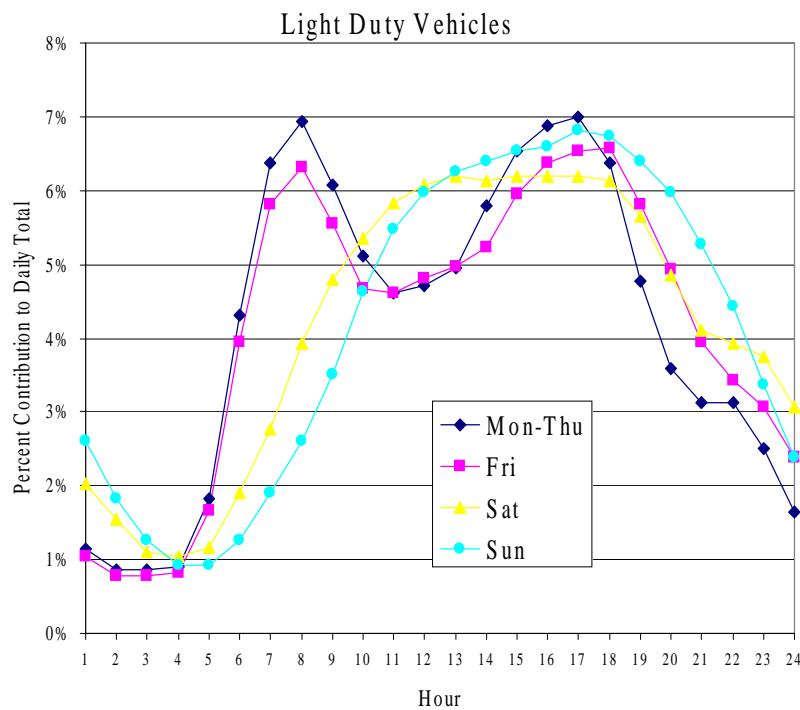


Weekday Temporal Profiles



- ROG temporal profiles for running emissions are similar to NOx

Vehicle Count Temporal Profiles



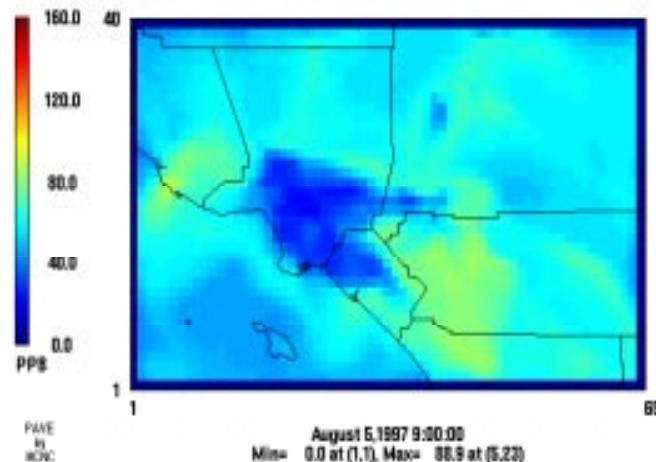
Initial Simulations

- **Naming convention follows Workplan presented November 16, 1999**
 - wd_base
 - h1a: hypothesis 1 simulation (a), change MV emissions mass on Sat and Sun
 - h2a: hypothesis 2 simulation (a), change MV temporal profile on Sat and Sun
 - h2c: hypothesis 2 simulation (c), change MV mass and temporal profile on Sat and Sun
- **Tile plots show ozone for bas case, ozone change for scenarios (e.g., h1a - wd_base)**

Ozone: Saturday, 9 am

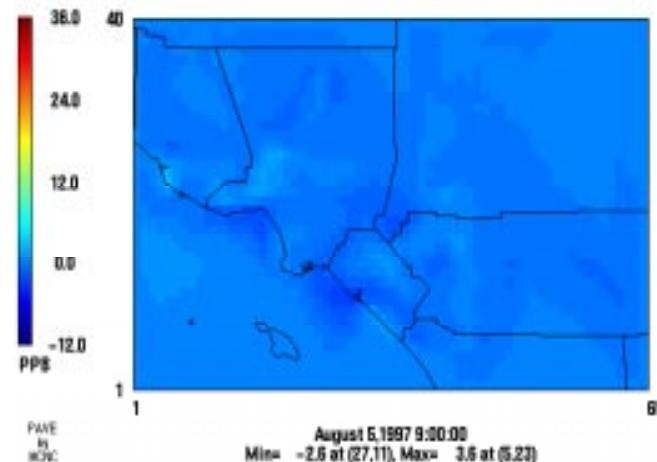
Base Case (run=wd_base)

CRC Proximate Modeling – Surface Ozone (ppb)



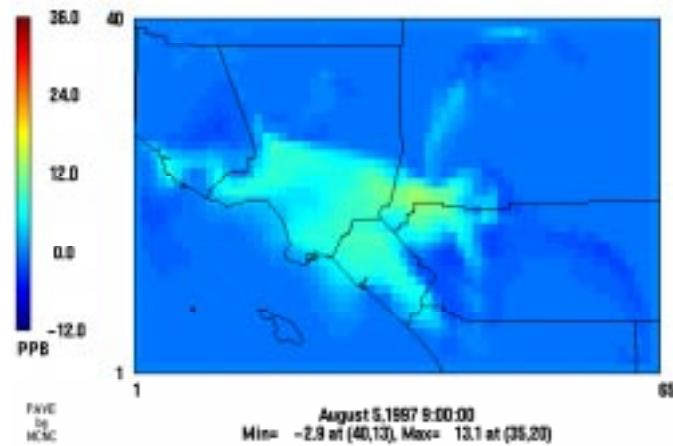
Change MV Temporal Profiles (run=h2a)

CRC Proximate Modeling – Surface Ozone Change (ppb)



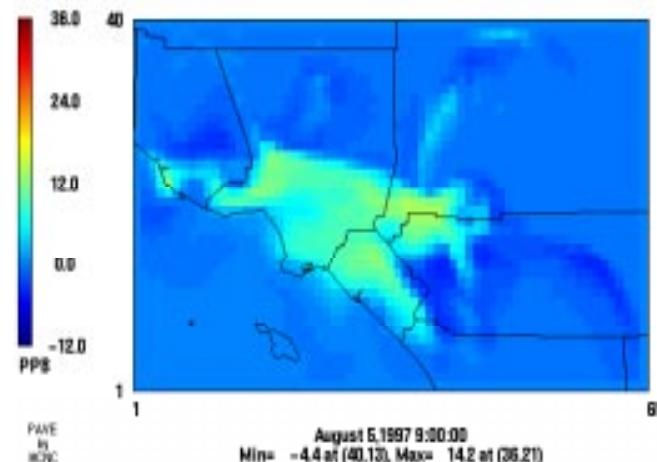
Change MV Mass (run=h1a)

CRC Proximate Modeling – Surface Ozone Change (ppb)



Change MV Mass & Temporal (run=h2c)

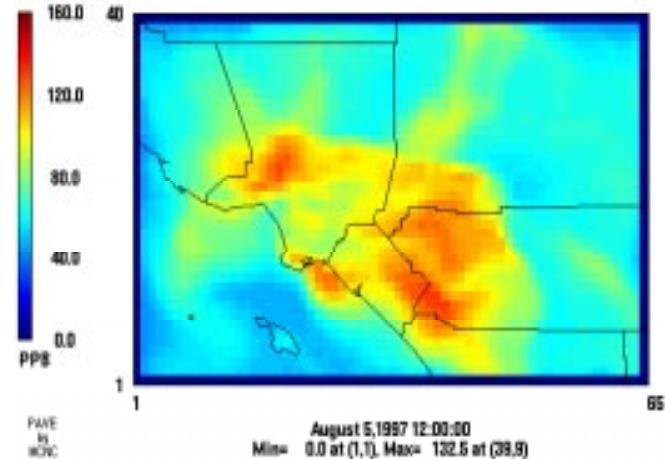
CRC Proximate Modeling – Surface Ozone Change (ppb)



Ozone: Saturday, noon

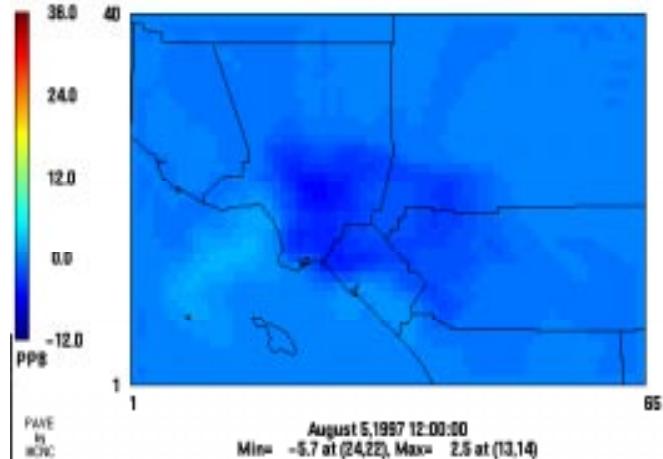
Base Case (run=wd_base)

CRC Proximate Modeling – Surface Ozone (ppb)



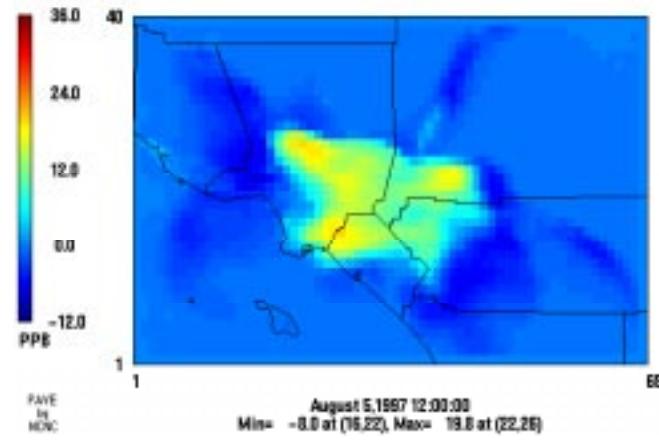
Change MV Temporal Profiles (run=h2a)

CRC Proximate Modeling – Surface Ozone Change (ppb)



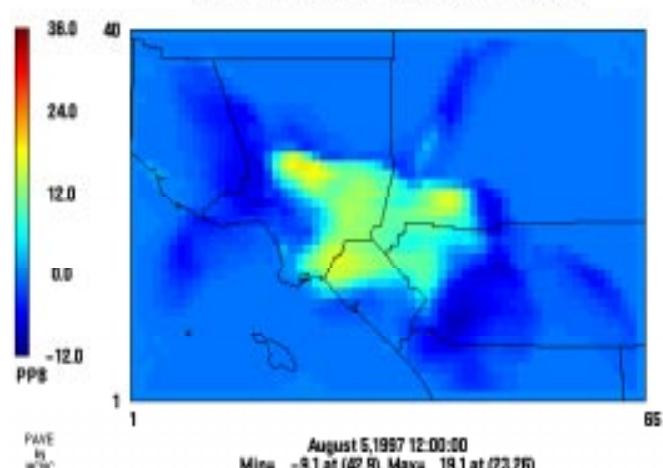
Change MV Mass (run=h1a)

CRC Proximate Modeling – Surface Ozone Change (ppb)



Change MV Mass & Temporal (run=h2c)

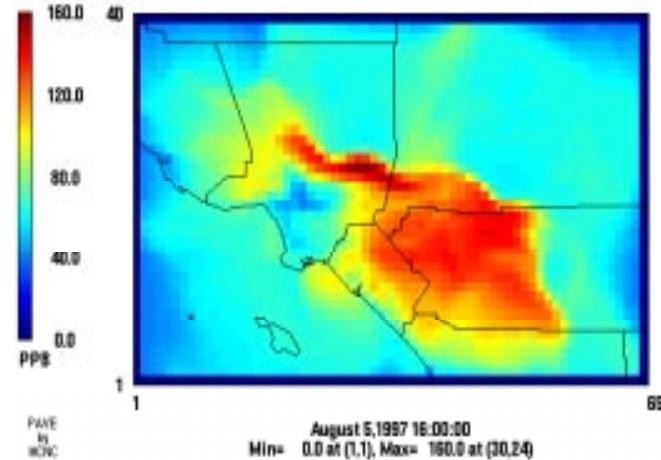
CRC Proximate Modeling – Surface Ozone Change (ppb)



Ozone: Saturday, 4 pm

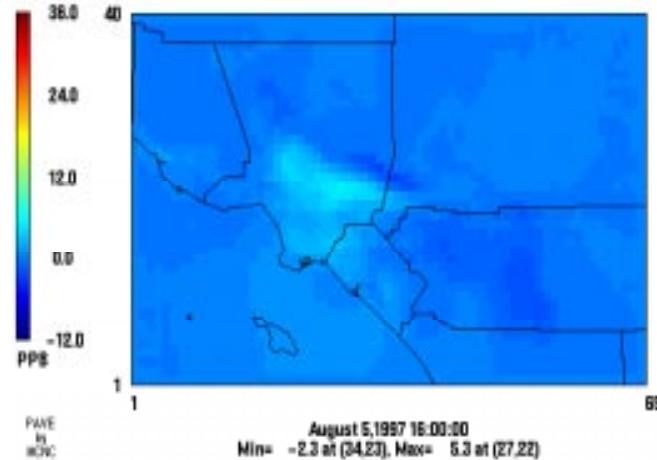
Base Case (run=wd_base)

CRC Proximate Modeling – Surface Ozone (ppb)



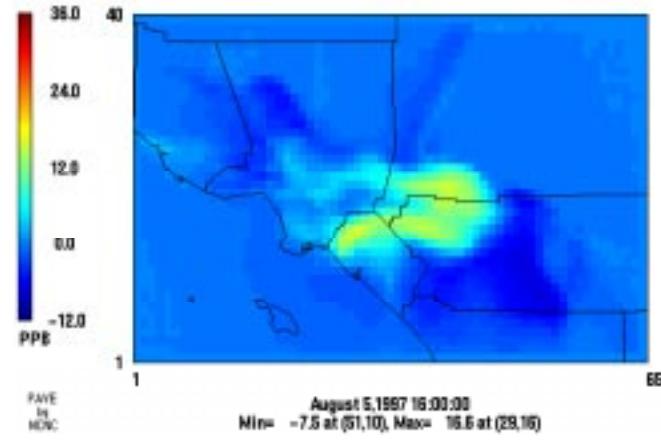
Change MV Temporal Profiles (run=h2a)

CRC Proximate Modeling – Surface Ozone Change (ppb)



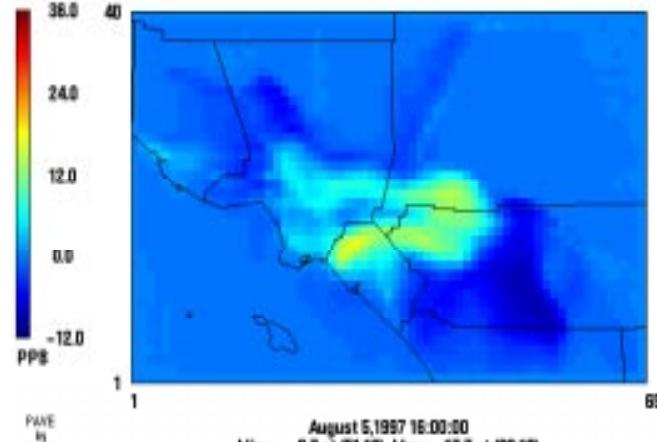
Change MV Mass (run=h1a)

CRC Proximate Modeling – Surface Ozone Change (ppb)



Change MV Mass & Temporal (run=h2c)

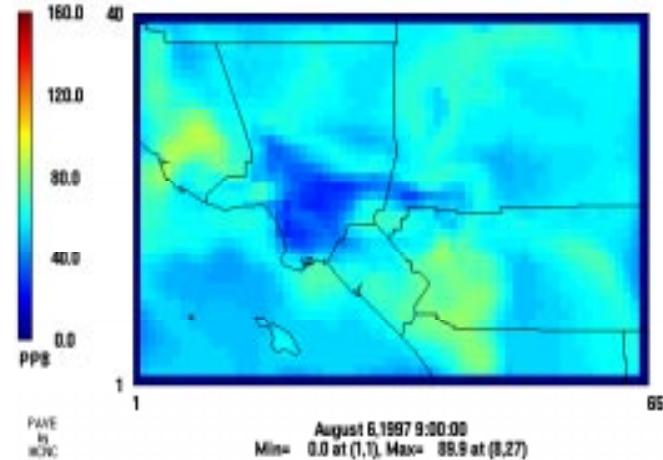
CRC Proximate Modeling – Surface Ozone Change (ppb)



Ozone: Sunday, 9 am

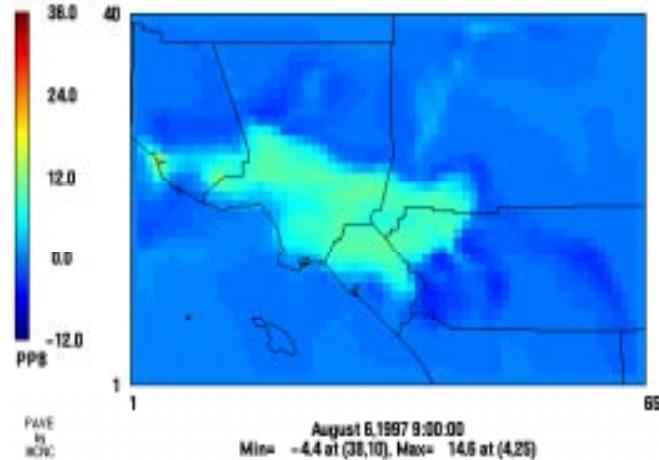
Base Case (run=wd_base)

CRC Proximate Modeling – Surface Ozone (ppb)



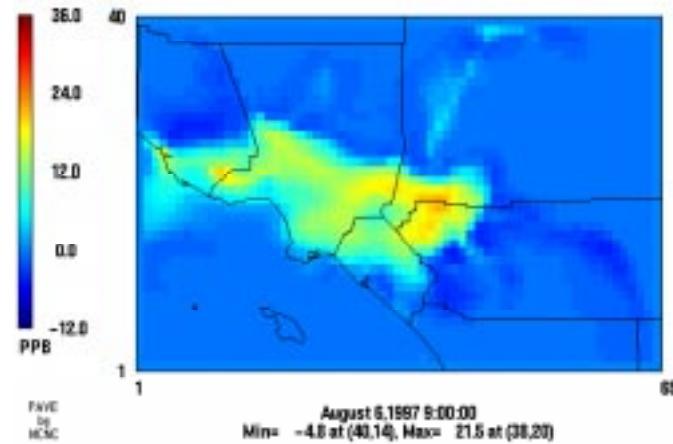
Change MV Temporal Profiles (run=h2a)

CRC Proximate Modeling – Surface Ozone Change (ppb)



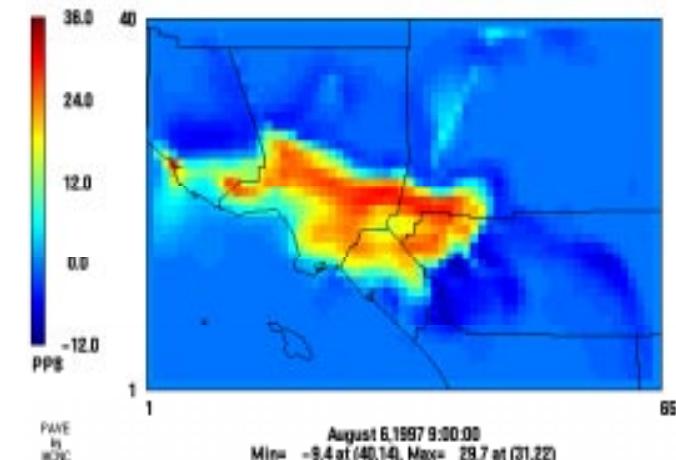
Change MV Mass (run=h1a)

CRC Proximate Modeling – Surface Ozone Change (ppb)



Change MV Mass & Temporal (run=h2c)

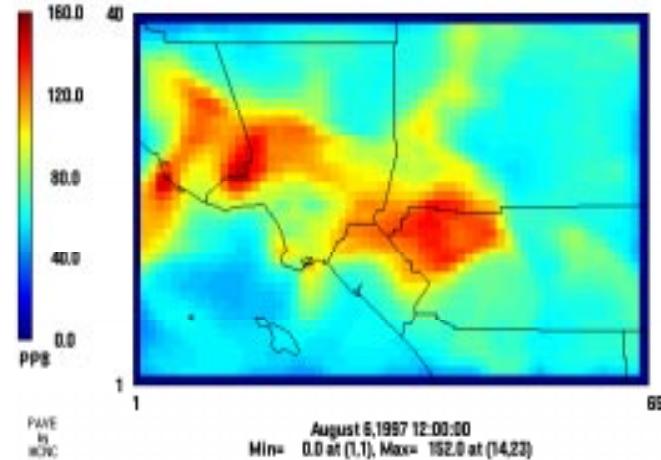
CRC Proximate Modeling – Surface Ozone Change (ppb)



Ozone: Sunday, noon

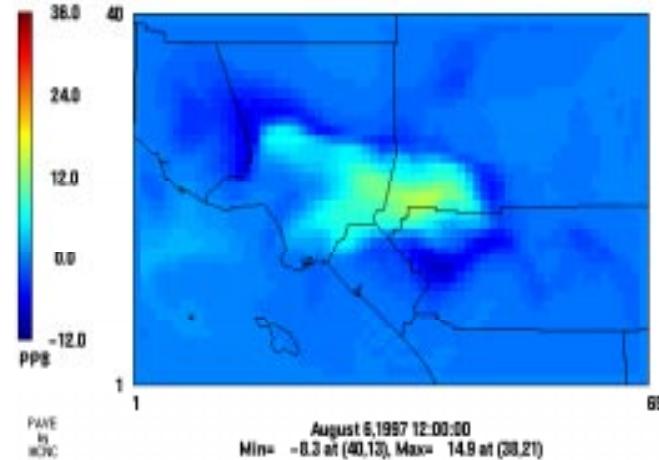
Base Case (run=wd_base)

CRC Proximate Modeling – Surface Ozone (ppb)



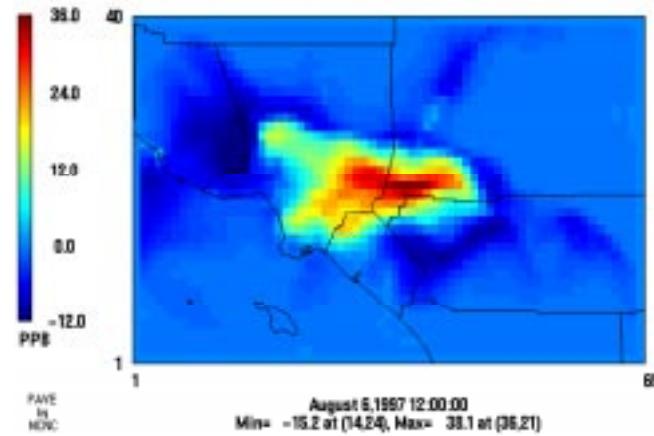
Change MV Temporal Profiles (run=h2a)

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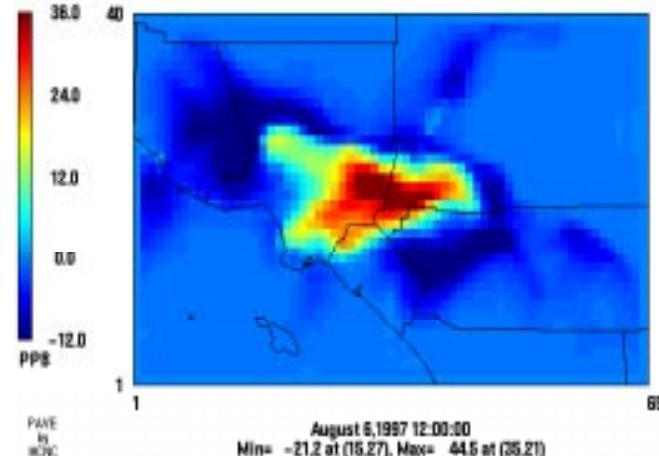
Change MV Mass (run=h1a)

CRC Proximate Modeling – Surface Ozone Change (ppb)



Change MV Mass & Temporal (run=h2c)

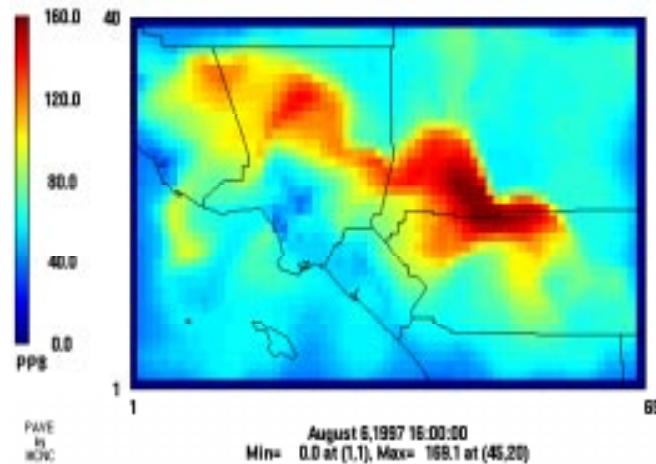
CRC Proximate Modeling – Surface Ozone Change (ppb)



Ozone: Sunday, 4 pm

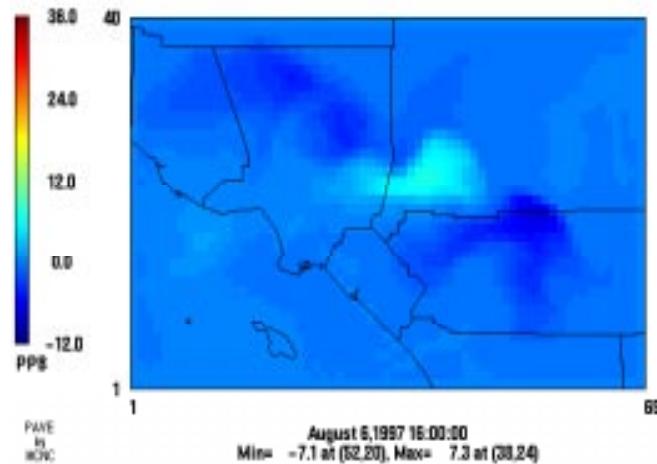
Base Case (run=wd_base)

CRC Proximate Modeling – Surface Ozone (ppb)



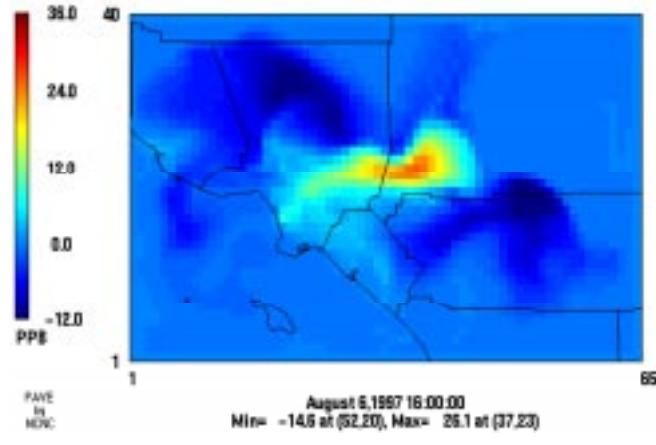
Change MV Temporal Profiles (run=h2a)

CRC Proximate Modeling – Surface Ozone Change (ppb)



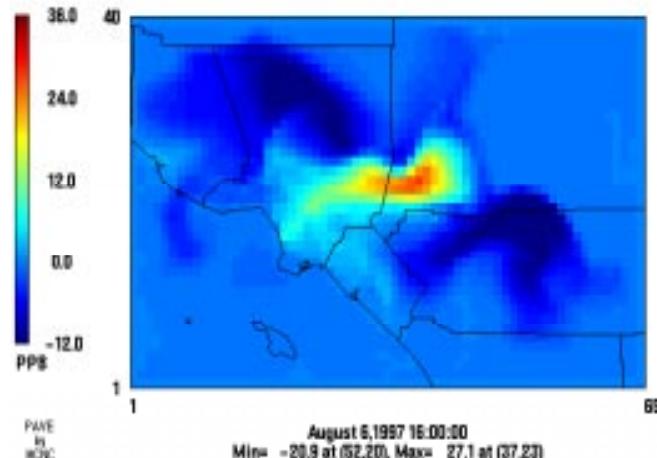
Change MV Mass (run=h1a)

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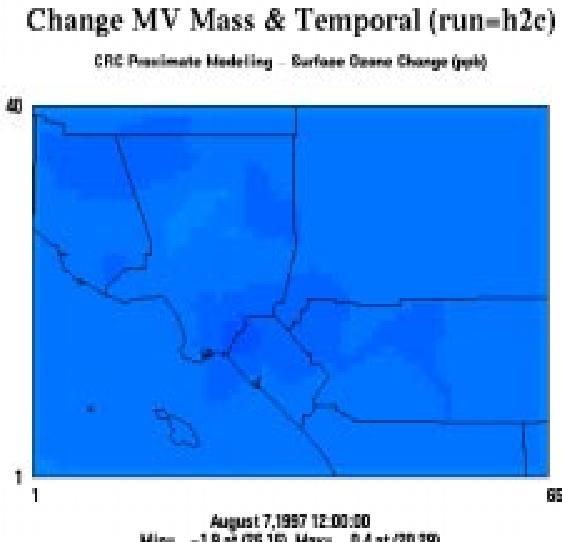
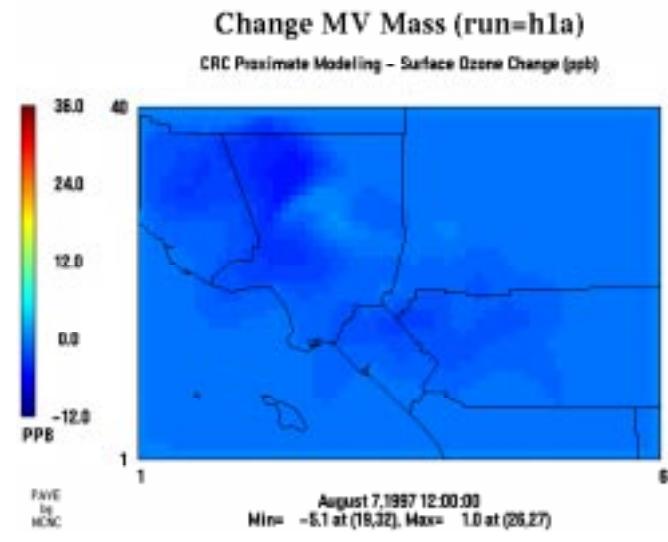
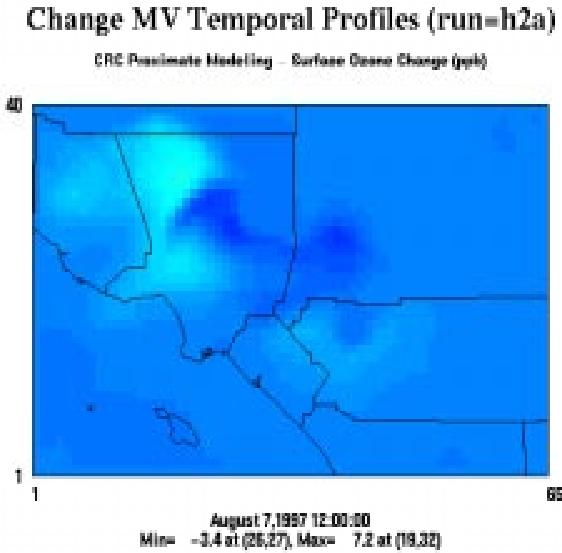
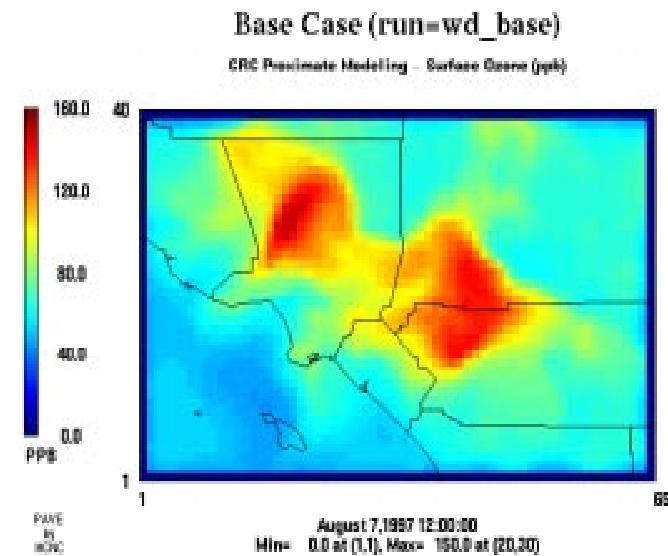


Change MV Mass & Temporal (run=h2c)

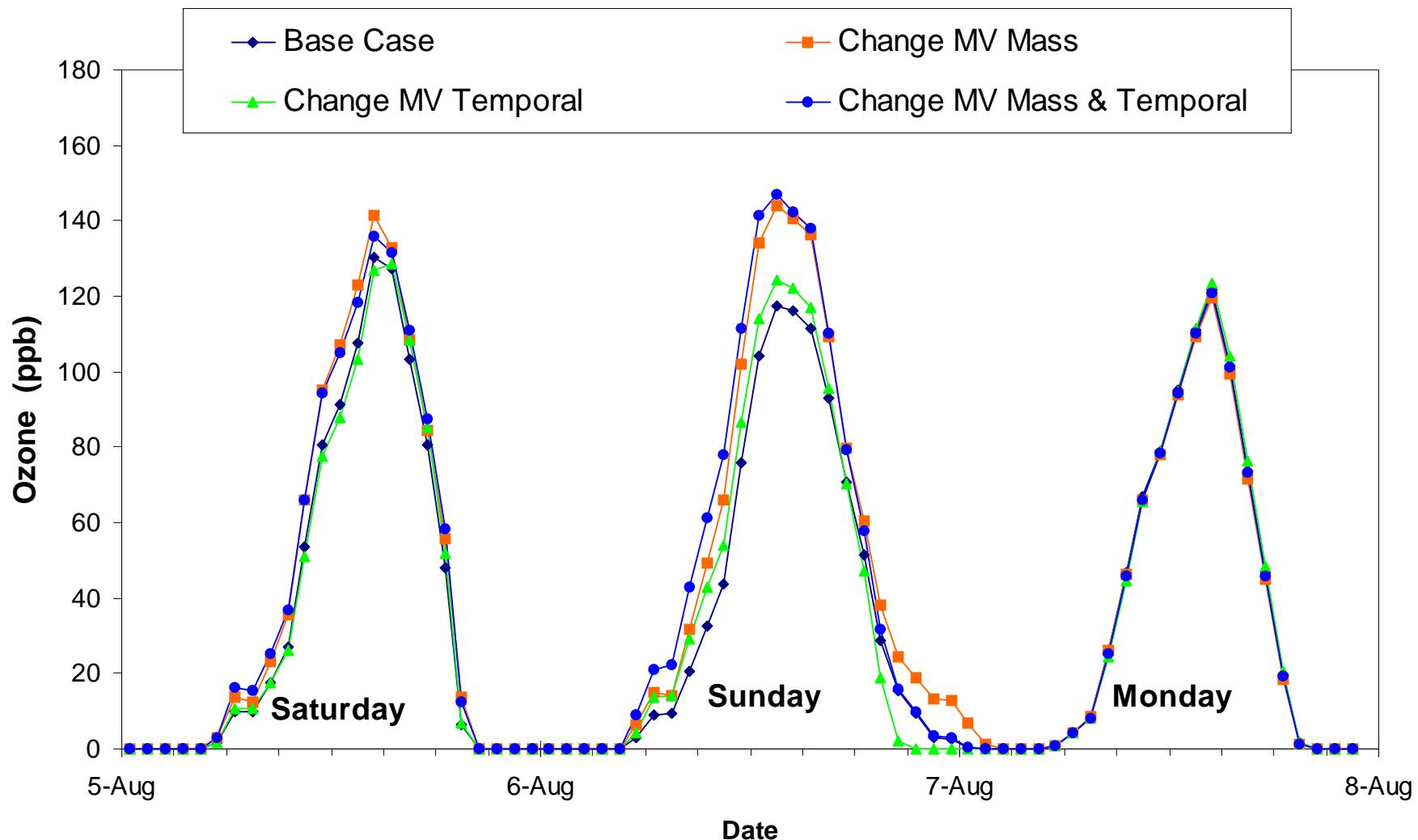
CRC Proximate Modeling – Surface Ozone Change (ppb)



Ozone: Monday, noon

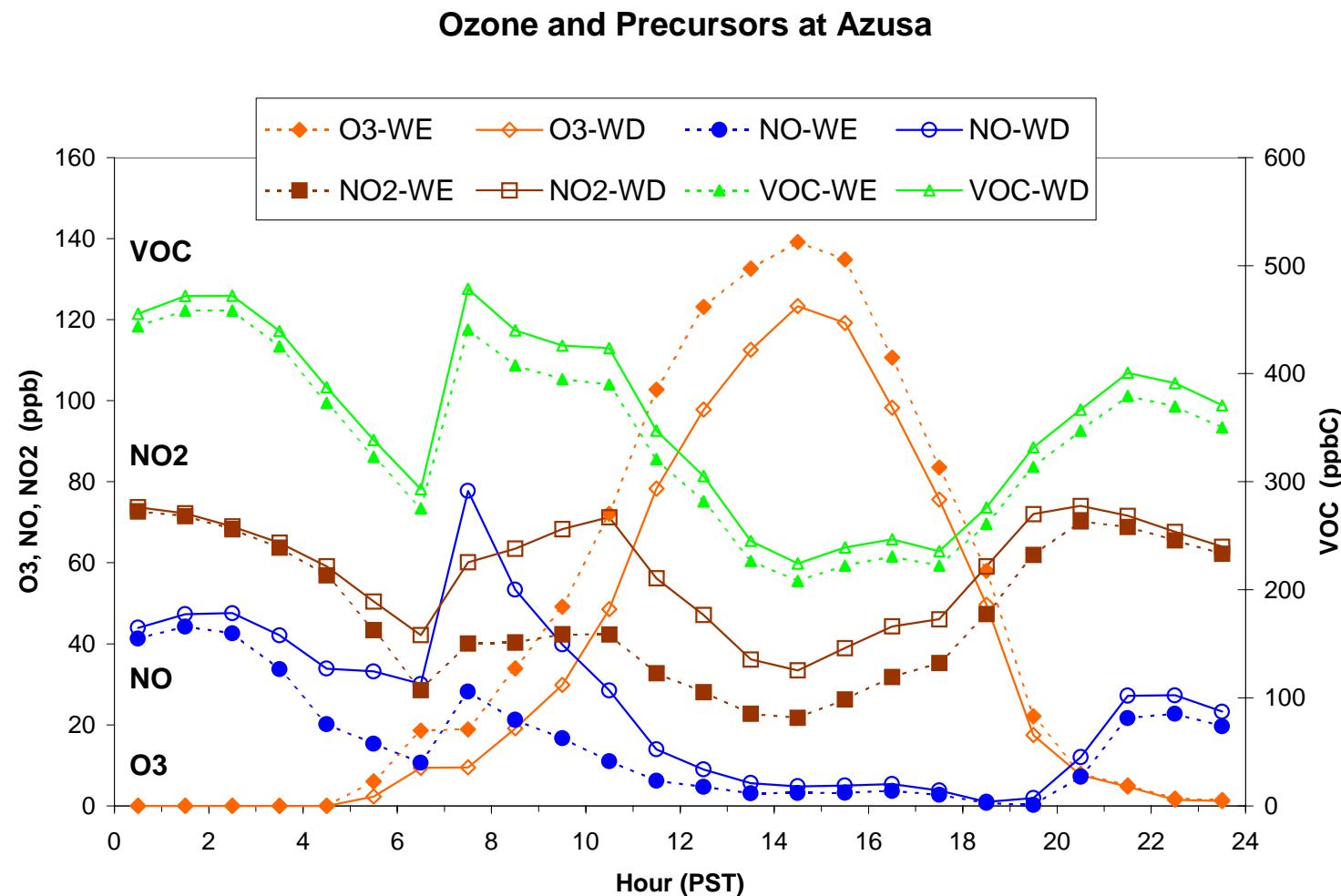


Weekend Ozone Effect at Azusa

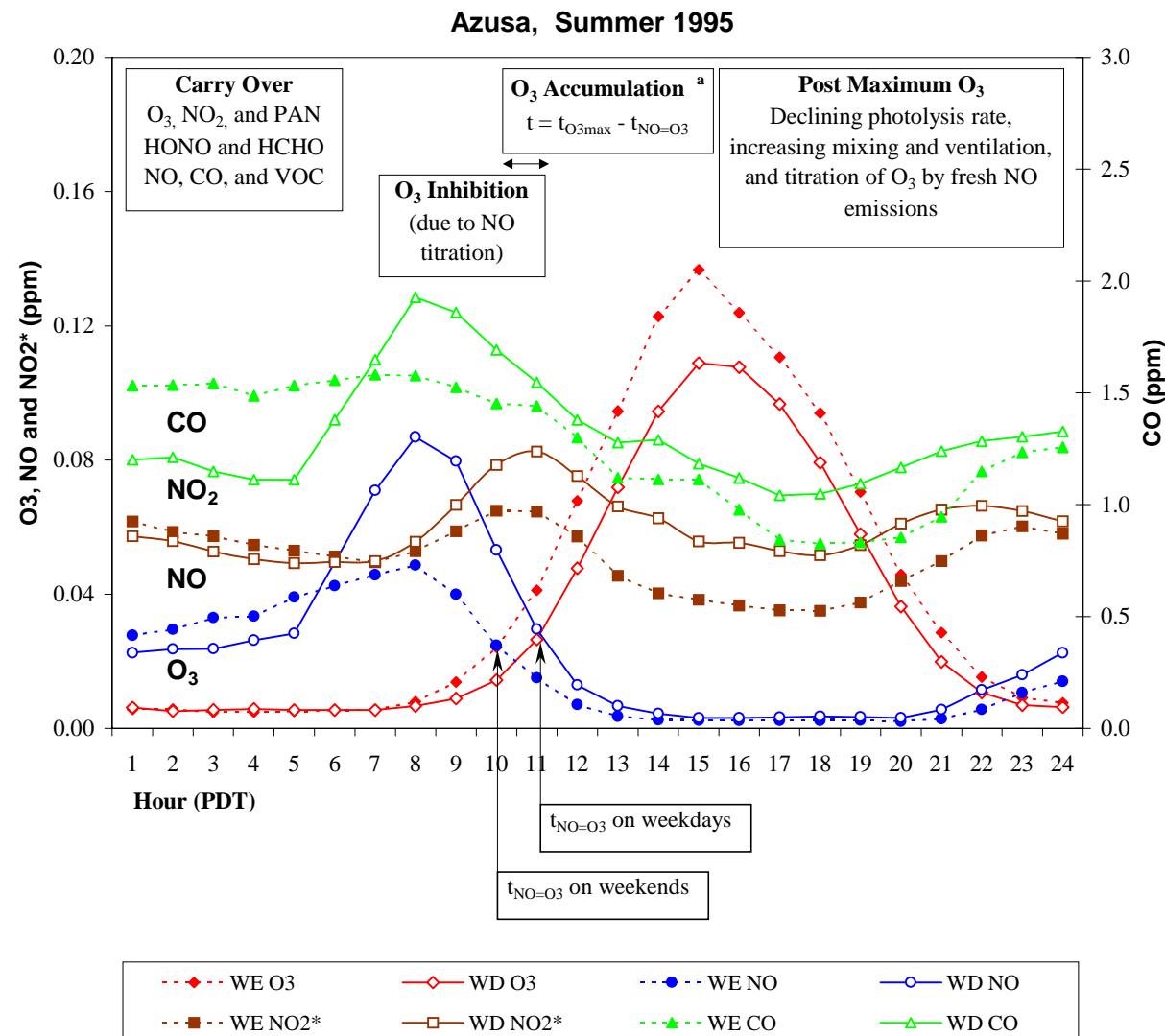


Azusa

Azusa: Change MV Mass and Temporal



Azusa: Observed WE Effect



* Figure courtesy of Eric Fujita, DRI.

<http://www.arb.ca.gov/aqd/weekendeffect/nre1p1v1f.pdf>

Summary (1 of 2)

- **Changes to the mass of onroad MV emissions produced large ozone increases on Saturday and Sunday**
- **Changes to the temporal profile of onroad MV emissions produced little ozone increase on Saturday, some ozone increase on Sunday**
- **Ozone increases are comparable to observed effects for both the mass change and mass/temporal change scenarios**

Summary (2 of 2)

- **For the mass/temporal scenario, the modeled WD/WE effect for ozone and precursors at Azusa is strikingly similar to DRI's analysis of 1995 data**
- **There is very little carryover of effects from Sunday to Monday**